Safety in Ice Hockey
6th Volume

Editors:
Terry A. Smith
Alan B. Ashare

ASTM INTERNATIONAL
Selected Technical Papers

ISBN: 978-0-8031-7696-6
Stock #: STP1625
www.astm.org
Editors: Terry A. Smith and Alan B. Ashare

Safety in Ice Hockey: 6th Volume

ASTM STOCK #STP1625
DOI: 10.1520/STP1625-EB
Foreword

THIS COMPILATION OF Selected Technical Papers, STP1625, Safety in Ice Hockey: 6th Volume, contains peer-reviewed papers that were presented at a symposium held May 13, 2019, in Denver, CO, USA. The symposium was sponsored by ASTM International Committee F08 on Sports Equipment, Playing Surfaces, and Facilities and Subcommittee F08.15 on Ice Hockey.

Symposium Chairs and STP Editors:

Terry A. Smith
Dynamic Research, Inc.
Torrance, CA, USA

Alan B. Ashare
St. Elizabeth’s Medical Center
Tufts University School of Medicine
Boston, MA, USA
## Contents

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 Years of Safety in Ice Hockey: What Have We Learned and Where Do We Need to Go?</td>
<td>1</td>
</tr>
<tr>
<td>Patrick J. Bishop</td>
<td></td>
</tr>
<tr>
<td>2008–2017 Emergency Department-Treated Ice Hockey Injury Estimates</td>
<td>8</td>
</tr>
<tr>
<td>Ted Yang</td>
<td></td>
</tr>
<tr>
<td>Comparison of Head Impact Frequency and Magnitude for Midget and Junior Ice Hockey Players to Inform Safety and Policy</td>
<td>21</td>
</tr>
<tr>
<td>Leah E. McMunn, Thomas B. Hoshizaki, Michael Robidoux, Michael D. Gilchrist, Clara Karton, and Andrew Post</td>
<td></td>
</tr>
<tr>
<td>Summary of Accurate and Precise Head Impacts Collected On-Ice in Hockey Players and How These Data Will be Used to Improve Equipment and Rules for Safer Play</td>
<td>45</td>
</tr>
<tr>
<td>Adam J. Bartsch, Edward C. Benzel, Sergey Samorezov, and Vincent J. Miele</td>
<td></td>
</tr>
<tr>
<td>Developing a Linear Impactor Test Method for Ice Hockey</td>
<td>64</td>
</tr>
<tr>
<td>Christopher Withnall, Michael Wonnacott, and James Searle</td>
<td></td>
</tr>
<tr>
<td>Pressure, Aggression, and Fighting: The Role of Psychosocial Factors in Acute Concussions during Junior A Hockey</td>
<td>82</td>
</tr>
<tr>
<td>Michelle H. Caputi, Aynsley M. Smith, Kristen M. Erredge, and Michael J. Stuart</td>
<td></td>
</tr>
<tr>
<td>Gender Differences in Concussion Symptomatology in Young Adult Ice Hockey Players</td>
<td>93</td>
</tr>
<tr>
<td>Rosemarie Scolaro Moser and Philip Schatz</td>
<td></td>
</tr>
</tbody>
</table>
Overview

This is the sixth proceedings based on a series of presentations addressing issues of safety, injury prevention, and decreasing the risk of catastrophic injury in ice hockey—the first being published from the symposium held in 1987 at Montreal, Canada. These symposia have been held every five-to-six years, which we feel is an adequate time for new ideas to be formulated and new research to come to the forefront. The idea of the symposium is to present the latest findings, research, and countermeasures related to safety in ice hockey. The symposium provides opportunity for discussions by all those that participate in the game of hockey and promotes the development of both short-term and long-term strategies for decreasing the risk of both acute and long-term injury, particularly brain injury. The topic of brain injury is not confined to ice hockey, and other sports are facing similar issues related to how the game is played. For this reason, we have much to learn from each other and these presentations bring together researchers from a diverse group of fields, including sports medicine, bioengineering, mechanical engineering, neuropsychology, sports litigation, and sports epidemiology.

The game of ice hockey is constantly evolving in terms of better training methods, improved coaching techniques, more protective equipment, and a better understanding of ice hockey injuries and their mechanisms. We know much more than we did ten years ago and significantly more than when we held our first symposium in 1987. As researchers, coaches, players, and parents the amount of information available to us on a daily basis is staggering. One of the most important components of this symposium is to gather the most current and relevant research and put it together into a package that can be used and understood by all of us that love the game of hockey.

This symposium has focused upon four key topic areas:

- The Scope of the Problem: This session will provide background and injury data so we can identify injury patterns in the game.
- Biomechanical Studies: This session will introduce new research in ice hockey as well as other contact sports that are providing tremendous new insight into injuries and injury mechanisms.
- Clinical Observations: This session will describe some of the clinical symptoms of injured players and identify factors that are fundamental to keeping the game safe and maximizing the safety of all players.
- Countermeasures: Different regions of the country have different strategies to reduce the severity and frequency of injuries in the game. This session will describe some of those approaches.
The topic of concussion and its long-term consequences is now deeply embedded in the minds of all of us that participate in contact sports. Advanced data collection technologies have greatly improved our ability to monitor head impacts in the real world and the analysis of that data has provided new insight into the biomechanics of head impacts. For this reason, we have invited researchers from other contact sports to provide some of the lessons that they have learned from their efforts.

All of us have the ability to identify the problem, but it will take a multi-disciplinary group effort to develop appropriate countermeasures to reduce the risk and severity of these devastating injuries. There are inherent risks to playing the game of ice hockey, but with a better understanding of the injuries, the mechanisms of those injuries, good equipment, good coaching and respecting the rules, we can make this game fun for everyone.

We would like to acknowledge the support and efforts of various individuals at ASTM. Isabel Wright was Chairman of F08 when this symposium was being planned and was extremely supportive and helpful. Joe Koury, Staff Manager of F08, provided both on-site logistical support and expertise in planning. Kelly Dennison-Ansuini of ASTM Symposia Operations was essential in the coordination and execution of the symposium.

Upon completion of the symposium, Alyssa Conaway and Sara Welliver worked tirelessly through the editorial process, keeping the editors on track and making sure everything was in place for the final process of completing and publishing this STP.

We acknowledge the financial support of HECC (Hockey Equipment Certification Council), USA Hockey, and USA Hockey Foundation. We want to thank Len Clement, President of HECC, for his support. We want to thank the leadership of USA Hockey and USA Hockey Foundation, Jim Smith, President, Pat Kelleher, Executive Director and Bill Hall, Secretary, for their support and encouragement for this project. We also thank our colleagues, the researchers, the rink managers, the manufacturers, the safety enthusiasts, the players, and their families for their great interest in the prevention of injuries and promotion of safety for all hockey players. Hockey is a great game.

Symposium Chairs and STP Editors:

Terry A. Smith, PhD
Dynamic Research Inc.
Torrance, California

Alan B. Ashare, M.D.
St. Elizabeth’s Medical Center
Tufts University School of Medicine
Boston, Massachusetts